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COOPERATIVE TOPOGRAPHIC MAPPING
IN CALIFORNIA

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COOPERATIVE TOPOGRAPHIC MAPPING IN CALIFORNIA

Conrad A. Ecklund

This paper will present a record of the topographic mapping accomplished in the State of California with particular emphasis on surveys made by the United States Geological Survey under cooperative agreements with the State and other local agencies. It will point out the progress made in methods and procedures; the improvements that have taken place in instruments and equipment; and the inventions and adaptation of new mapping tools, the use of which have brought about in recent years revolutionary changes in the Science of Topographic Mapping. Because mapping in any one State is so interwoven with, and related to, the national effort, certain aspects of the overall mapping program will be referred to when relevant.

The demand for investigative work from a Government Scientific Bureau almost always exceeds that which can be accomplished with the funds appropriated for such work by Congress. Therefore a choice must be made of the most pressing projects in a large program or an attempt must be made to complete the entire program hurriedly and inadequately. In the former instance, other items hardly less urgent must be indefinitely postponed, and in the second case, incomplete and possibly inaccurate information would be obtained and very likely the work must later be repeated. This has, to a large extent, been the history of topographic mapping in the United States.

There is ample justification for the rapid and exploratory type mapping that was done in the years before and for some time after the Geological Survey was created by an Act of Congress in March 1879. The country was still new and unexplored. The discovery of gold in California in 1849 focused the attention of the whole world on California and resulted in a great westward migration. With this movement of the peoples and the fantastic stories of the opportunities that awaited them in the West, a natural demand developed for more information regarding our vast western empire. The Civil War, although it had temporarily slowed down the migration, had, on the other hand, created unrest and dissatisfaction which led to speedy resumption of the westward movement after the close of the war. It was under these conditions that the early exploratory surveys under King, Hayden, Wheeler, and Powell were born and flourished for a few years, until rivalries and overlapping of effort resulted in their abolition and the creation of the Geological Survey as their successor.

Although the authority for topographic mapping was not clearly defined in the Organic Act of 1879, the intent was clear, and a relatively large share of appropriated funds was apportioned to such mapping. Even so, the amounts allotted for topographic mapping failed to entirely satisfy the requirements of certain States and they proceeded to set up their own Survey organizations. Thus, early in the history of the U. S. Geological Survey the critical question whether State and Federal Surveys should be competitive or coordinated was answered by a declaration of Federal policy urging the creation and continuation of State Surveys. This led to cooperation between the Federal Government and the States as well as other local governmental bodies whereby the

cost of mapping was shared, usually on a 50-50 basis. How effective this cooperation has been is shown by the fact that during the fiscal year 1951, States, Counties, and Municipalities allotted a total of one and a quarter million dollars for topographic mapping which was matched by an equal amount of Federal funds. This is unmistakable evidence of the prevailing spirit of cooperation between Federal and local governmental bureaus and that they have a common interest in the possession of adequate basic data covering their territories. The advantages to the cooperators are many. They utilize the trained expert personnel and standardized methods of the Geological Survey; they exercise control over the areas selected for mapping; overhead costs are limited to one administrative organization; duplication of work is avoided; and results of work have a uniformity which make them more useful and a high standard which is generally recognized and widely accepted.

In 1903 California entered the field of cooperative mapping with an initial allotment of \$10,000, and this cooperation in varying amounts has since been continued. Counties, municipalities and local boards and commissions as well as the State have participated in cooperative mapping in California, but the bulk of the work has been in cooperation with the State, the State funds being administered by the State Engineer. However, it should be remembered that in addition to cooperative work, a considerable amount of mapping was in progress in the United States as well as in California which was financed entirely with Federal funds.

In the fiscal year 1904, when California began its cooperative program with the Geological Survey, the latter organization had been in existence about 25 years, and it might be interesting to take stock of the accomplishments during this first quarter of a century and the status of mapping at the close of that period. The figures may be startling in view of current statements to the effect that the United States is now, in the year 1952, only about 30 percent adequately mapped. It must be remembered, however, that the early mapping, particularly in the West, was largely reconnaissance in nature, the usual publication scales being 1:125,000 and 1:250,000. Most of these maps are now obsolete and many are out of print.

The annual report for the fiscal year 1904 shows that at the end of that year approximately 26 percent of the United States, exclusive of Alaska, had been mapped. The total Congressional appropriation that year for topographic mapping was a little over \$300,000. Eleven States including California contributed a total of about \$105,000 for cooperative mapping which was matched by about an equal amount of Federal funds, thus raising the grand total for topographic mapping in the Nation for that year to \$405,000. In California, 2,532 square miles were mapped increasing the total for the State to 67,148 square miles or 42 percent of the State's area. This was a creditable accomplishment and provided complete coverage for the northeast part of the State; most of the high Sierras as far south as Kings River; the coastal area from San Diego to San Luis Obispo; and a dozen or so quadrangles in the San Francisco Bay area. In addition, two or three quadrangles along the Colorado River had been mapped. Available maps at this time totalled 120 and were on scales ranging from 1:14,400 (1200 ft. to 1 inch) to 1:250,000 (approximately 4 mi. to 1 inch) with contour intervals ranging from 20 feet to 200 feet.

In the early 1900's the Nation was beginning to awaken from the delusion that natural resources, including land and water, were unlimited. Previously there had always seemed to be room to spare regardless of how rapidly the population was growing. Lumber from the vast forests was plentiful, and if a mineral vein pinched out, another was certain to be found. As the need for

more farms and farm products increased, people were drawn into the semi-arid lands of the far west, and in these areas they soon learned that water is of prime importance and not to be wasted. Gradually there developed a realization that our use of natural resources had been wasteful and the idea of conservation began to take hold. This change in attitude was translated into legislative action so that during the first three decades of the century, the Federal Government passed several acts relating to conservation. The growing agitation for conservation led California to review its mapping needs and, whereas mapping in California up to this time had been largely confined to the high mountain areas and centers of population along the coast, the interest now turned to an increasing extent to the large interior valleys and the watersheds of the principal rivers. Specialized irrigation farming was developing rapidly in the State. Also, with the passing of the Reclamation Act in 1902, which was designed to promote the conservation and proper use of water in the West, the interest in irrigation which had previously been strong was intensified. As a result of this, the legislature in 1903 provided funds for cooperation with the Survey for gaging streams, conservation and utilization of flood and storm waters, and topographic mapping. For the first 3 years, this program was sponsored by the State Board of Examiners, but in 1907 this responsibility was transferred to the State Engineer's office where it has since remained. The locality selected for the first work under this cooperative agreement was the northern or upper end of the Sacramento Valley where mapping on the Vina and Tehama quadrangles was initiated.

Although the valley areas were considered to be of vital importance to the State in its water-development program, the legislature was apparently only mildly impressed, and as a consequence, the funds provided by them for this work during the next twenty years averaged only about \$15,000 a year. Even with the matching funds provided by the Survey the total was still small considering the scope of the program. Nevertheless, the work progressed steadily but slowly until the mid-thirties when this phase of cooperative mapping in California was completed. The resulting maps provided topographic coverage for the two great inland valleys of the Sacramento and San Joaquin Rivers and extended from Redding on the north to below Bakersfield on the south, a distance of 400 miles. The average width of this combined valley empire is about 45 miles, and thus the area covered by this mapping totalled approximately 18,000 square miles. There resulted some 330 separate $7\frac{1}{2}$ -minute quadrangle maps published on a scale of 1:31,680 (2 inches = 1 mile) with a contour interval of 5 feet. The wide use that has been made of these maps through the years by both local and Federal agencies in planning water and power projects in the State, not to mention the many other uses to which these maps have been put, is ample evidence that the investment has paid for itself many times over. The maps are evidence of a far-sighted point of view on the part of those responsible for initiating the project and carrying it through, particularly because the scale and contour interval employed indicate a full appreciation of the important part they were to play in the development of the State. They satisfied the need for topographic mapping in the Central Valley for many years, although the extraordinary developments during the past forty years eventually rendered them seriously out of date in some respects. Their revision became a necessity in order that their usefulness might be continued. This work was started several years ago and is still in progress.

At the close of the 1903 field season and probably because of the newly inaugurated cooperative program, the Geological Survey opened an office in the Post Office Building at Sacramento where the office work and map-finishing

phases of California mapping was to be performed. R. B. Marshall, who was later to father the Marshall Plan, the fore-runner of the present Central Valley Project, was placed in charge of this office. Soon thereafter this office was expanded to become the field headquarters for topographic-mapping operations for all the far-western states and has been maintained continuously up to the present time.

In 1923 cooperative mapping in California was substantially increased by the initiation of a cooperative agreement with the County Surveyor and Engineer of Los Angeles County for the complete mapping of the County. Under this agreement the County was to provide funds for five-eighths of the cost of the job, the remaining three-eighths to be paid by the Geological Survey. The unequal division of costs in this case was in accordance with the law and accepted policy of the Geological Survey at that time, and for some years thereafter, which required the cooperating agency to contribute a larger share as compensation for the increased costs of performing the mapping on scales larger than the standard, which at that time were 1:62,500 and 1:31,680. The specifications for the County project provided for mapping and publication on a scale of 1:24,000 with five-foot contours to be used in the valleys and gently sloping terrain, and twenty-five-foot contours for the hilly and mountainous country. The specifications also stipulated that the maps be printed in six-minute units whereby each map was to embrace six minutes of latitude and six minutes of longitude. This was a departure from standard practice to meet the special needs of the County. The project continued for fifteen years, being completed in 1937, and produced 112 six-minute quadrangles covering a total area of over 4,000 square miles. The contribution to the overall mapping of the State amounted to about 2½ percent. A statement of costs for this project would be meaningless in view of the increases in costs of services and commodities which have taken place since the Los Angeles County mapping was initiated. Also, the records at hand are hazy as to the amount of money contributed individually by the State and County during this period. However, the contributions made by the State and County for topographic mapping in Los Angeles County and elsewhere in the State for the fifteen years, 1923 to 1937 inclusive, total approximately \$653,000. The Federal contribution during this same period amounts to about \$467,000. It is estimated that of this total of \$1,120,000, the amount spent on the County mapping was \$670,000 during the term of the agreement.

The plane-table method of mapping was used for all the Los Angeles County work as well as for the concurrent mapping in the San Joaquin Valley and elsewhere in the State. However, aerial photographs were available for the Los Angeles area, and to the best of my knowledge, it was the first time that the Geological Survey made use of the photographs for mapping on a large project in California. Studies had been made by the Geological Survey during and immediately following World War I indicating that aerial photographs might do much to improve mapping methods and accuracy; but no standardized procedures had been developed. Consequently, the aerial photographs of Los Angeles County were used in large part merely as an aid in delineating cultural features. However, during the last several years of the project, the topographers on the job compiled a considerable amount of radial-line planimetry on a day-to-day basis and as needed for the succeeding several days' field sketching. However crude this compilation may have been, and compared to present-day precision methods it definitely was crude, it produced a more detailed and accurate drainage pattern than could have been obtained by plane-table methods alone, and almost equally important, it saved the topographer

an immense amount of time and effort, particularly in the brushy and inaccessible mountainous terrain.

These maps have fulfilled a great local need and have played a major role in the tremendous development that has taken place in Los Angeles County during the last twenty-five years. The frequency and magnitude of the changes in highways, streets, and even topography have made it extremely difficult to keep these maps up-to-date. As early as 1926, only three years after the inauguration of the project, the County found it necessary to begin a modest revision program. The Geological Survey cooperated in this undertaking to the extent of making corrections to original plates and reprinting the maps periodically. All the field work in connection with this early revision was paid for by the County and performed by their personnel. Recently the Geological Survey took over the entire responsibility for revision of the Los Angeles County maps, and in the process of revision, the map sizes are being changed from the odd six-minute size to the standard 7½-minute series to conform with new mapping in the adjacent counties and in the State as a whole.

Following completion of the cooperative mapping in the Central Valley and Los Angeles County in the middle 1930's, contributions for cooperative mapping in California dwindled to the very small sum of \$5,000 a year and continued at this level until 1946.

Several other cooperative mapping projects, comparatively small in area, should be mentioned before passing on to the expanded State program inaugurated in 1946. In 1914 and 1915 the University of California cooperated with the Survey in the mapping of the Santa Rosa quadrangle, and in 1915 the City of Los Angeles contributed to the mapping of the Elizabeth Lake quadrangle. The East Bay Municipal Utility District, in connection with the development of a water-supply project in the Eel River Basin, cooperated with the Survey in the mapping of that basin in 1925. The last and largest of this miscellaneous group of cooperative projects was one in which three agencies shared costs with the Geological Survey for the mapping of the Shasta Valley in the extreme northern part of the State during the two years 1922 and 1923. The participating agencies were the Klamath-Shasta Valley Irrigation District, the U. S. Reclamation Service (as it was called in those days), and the State of California. The specifications for this project called for mapping on a scale of 1:24,000 with a contour interval of 5 feet. The total area mapped was somewhat over 400 square miles. The results of this mapping were prepared for one-color photolithography for use by the agencies directly concerned but were not published for general distribution. However, the mapping was later incorporated in published quadrangles of the area and thus contributed to the over-all mapping of the State.

During this period of cooperative mapping, that is, from 1903 through 1945, the Geological Survey carried on a concurrent limited program of mapping in California which was paid for entirely with Federal funds. Also by 1946, an area of about 20,000 square miles had been topographically mapped by the War Department, the U. S. Forest Service, and private mapping companies. In addition to this, the War Department had remapped or revised for military use many old Geological Survey maps. An important by-product of the mapping operations during these forty-odd years was the considerable network of horizontal and vertical control that had been established throughout the State. This consisted of monumented triangulation and traverse stations, and benchmarks marked on the ground by metal tablets, iron pipes, copper nail with washer, or bolts in structures. A considerable amount of the basic control was established by the U. S. Coast and Geodetic Survey and

is of first- and second-order accuracy. As the control established by the Geological Survey was primarily for use in topographic mapping, third-order accuracy was specified.

During the years 1930 to 1945 several abortive attempts were made to inaugurate an accelerated cooperative mapping program in the State of California. The most notable of these was the report in 1940 of the California State Planning Board entitled "Surveys and Maps in California". This report recommended a plan for coordinating the surveying and mapping activities in the State and outlined a program which, it was believed, would attract support of Federal, State, and local agencies of government, as well as many private, interests. These proposed programs failed to materialize because funds to implement them were not forthcoming from the local governments.

In 1945 the Geological Survey prepared an inventory of topographic mapping in California, which included an appraisal of the quality of the maps in order to determine whether they could be considered satisfactory for current needs or if they could be revised so as to restore their usefulness. This study had been suggested to the Survey by a group of interested individuals in California who were beginning to think about an expanded postwar mapping program for the State. The inventory and appraisal covered all topographic mapping in the State whether made by the Survey or by some other map-making agency. The results are taken from a report prepared by the Geological Survey in 1945 and are tabulated as follows:

TOPOGRAPHIC MAPPING IN CALIFORNIA As of March, 1945

Mapping By	Map Scale	Square Miles	Remarks
Geological Survey	1:250,000	15,475	Inadequate for present needs
Geological Survey	1:125,000	54,647	Inadequate for present needs
Geological Survey	1:62,500	19,010	Parts should be revised
Other Agencies	1:62,500	12,790	Recent Mapping
Geological Survey	1:31,680	17,865	Part should be revised
Other Agencies	1:31,680	6,770	Recent Mapping
Other Agencies	1:25,000	320	Recent Mapping
Geological Survey	1:24,000	4,016	Parts should be revised
Total area mapped		130,893	
Area of California		158,693	

It seems pertinent to point out that, although the inventory discloses the fact that in 1945 about 82 percent of the State was mapped topographically, more than half of this amount was considered inadequate; and of the remainder, two-thirds required revision to fully restore its usefulness.

This then was the situation in California with respect to topographic mapping near the close of World War II and, in general, similar conditions prevailed in the other States of the Nation. During the War the resources of all map-making agencies had been used to their full capacities in preparing foreign and domestic maps. It is undoubtedly true that in no previous war or during any similar period were so many maps prepared and so much use made of them. The stepped-up tempo of map making was made possible by the advancement that had been made in high-altitude photography, the improvement in precision aerial cameras, the development of new map procedures, and the perfection of stereo-plotting instruments. As a result of all this emphasis on

maps and improvement in equipment, there was, after the close of the war, a vast increase in map consciousness which soon created so large a demand for topographic maps that the combined efforts of all map-making agencies were unable to satisfy it.

It was during this period that California developed interest in stepping up the cooperative program which had been permitted to sink to an insignificant level throughout the preceding ten years. Under the sponsorship of the California State Reconstruction and Reemployment Commission, a State Aerial Mapping Committee was organized which, after an exhaustive study of the map situation in the State and consultation with representatives from State and Federal agencies, made a report, including recommendations, to the Director of the Commission. Among the items mentioned in this report were: (1) the Committee has as its objective the early completion of adequate basic maps to cover the entire State of California; (2) the program is to be carried on as a cooperative arrangement between the State and Federal agencies on a fifty-fifty basis; (3) the already-established arrangement of cooperation should be continued but the program should be greatly enlarged so as to complete mapping and revision of mapping within a period of ten years; and (4) this arrangement recognizes the U. S. Geological Survey as the agency to do the mapping, while the State Engineer, Division of Water Resources, administers the funds appropriated by the State. With the passage of a bill by the State Legislature, essentially as recommended by the Mapping Committee, there was authorized, late in 1945, a program of topographic mapping which it was hoped would lead to the complete coverage of the State with modern standard accuracy maps in ten years. A sum of \$300,000 was established as the annual appropriation by the State with an equal amount to be contributed by the Federal Government. This program went into effect immediately and is now in its seventh year.

About this same time, the Geological Survey was giving careful consideration to a twenty-year national program for the accomplishment of the immediate map requirements in an orderly fashion and to the extent permitted by its facilities. The result was an increase in appropriations for Federal mapping in the Nation and an added load for Pacific Region operations. The greatly augmented program placed a serious strain on the facilities of the Sacramento office of the Survey. Space, manpower, and equipment became immediate problems. So serious was the situation with respect to these items that, in order to allow time to prepare for the increased workload, it became necessary to budget a considerable part of the first year's appropriation for aerial photographs and to undertake a large revision program in the San Joaquin Valley. Accordingly, contracts were entered into with commercial companies for aerial photography covering over 12,000 square miles, including 900 square miles in the San Francisco Bay area and 3,600 square miles in the Fresno-Merced District. The latter area, embracing sixty $7\frac{1}{2}$ -minute quadrangles of the original San Joaquin Valley mapping, was set up for revision and became the first project under the expanded California cooperative agreement.

The development of the Multiplex projector instrument during the war years provided the Survey with a singularly efficient and flexible tool for the compilation of topographic maps--one that had not previously been generally available to the Survey. Utilizing aerial photographs, the Multiplex projector reproduces a stereoscopic model of the terrain covered by the photographs and thus brings into the office, as it were, the country to be mapped. The use of this and similar instruments has revolutionized the plane-table mapping procedures of earlier days. However, they have not entirely eliminated the

need for field surveys. Horizontal and vertical control are still required before the photographs can be properly set up for use in the projectors. Also, following stereo compilation, there still remain many items of map detail that require investigation and determination in the field. However, the science of photogrammetry, as applied to map compilation, has resulted in the production of a much more accurate map than was ordinarily accomplished by the earlier plane-table method of sketching. Particularly is this difference noticeable in inaccessible mountainous terrain. Economic reasons, under some conditions, still make it advisable to rely on the plane table for the sketching of contours in flat areas. In these cases a planimetric base is usually prepared by the Multiplex projector or other stereo-plotting instrument, and thus the old- and new-type instruments supplement each other in a very effective manner. The stereo-compiled map, in addition to excelling in accuracy, has the added advantage of providing large-scale advance prints at several stages during the course of map preparation, and this has proved to be of great benefit to map users pending the final publication of the completed map. Compilation by stereo-plotting instruments is done at large scales, usually from two to four times the publication scale. As soon as compilation is completed, blue-line prints at scales varying from 1:6,000 to 1:20,000 can be made available to those requiring them, and this can be repeated after field completion when additional information has been obtained in the field and applied to the map. After the final drafting and editing, a composite print becomes available which is comparable to, and on the same scale as, the published map. This composite is an ozalid print in one color whereas the final product is the well-known Survey quadrangle map, a multi-colored photolithograph.

The Geological Survey now utilizes the Multiplex or other similar stereo-plotting instruments in combination with theodolite, transit, engineer's level, and the plane table for all mapping. In connection with the present enlarged cooperative program in California, as well as on other projects, the Geological Survey has made considerable use of helicopters and walkie-talkie communication sets for field operations, radar equipment for determination of distances, and elevation meters and precision barometers for obtaining elevations.

The San Joaquin revision project and the procurement of aerial photographs, which had been agreed upon as the best means of getting the enlarged cooperative program under way, provided the time necessary for planning and scheduling full-scale operations. By the spring of 1946 the Survey was ready to give real impetus to the work, although space and manpower continued to plague us for some time. The general plan provided for two scales of publication and a variety of contour intervals depending on the character of the terrain and its economic importance. The mountainous areas of the Coast Range and the high Sierras, as well as the arid southeastern part of the State, were to be mapped for publication on a scale of 1:62,500. The large valleys, industrial centers, and areas of importance for the development of water, power, and other natural resources were planned for publication on a scale of 1:24,000. Contour intervals varied from 5 to 100 feet, although several years after the program became effective the policy respecting contour intervals was changed and thenceforth, with few exceptions, the 5-10-20-40 series with occasional use of the 80-foot interval for extremely steep terrain, became standard practice. Provision was also made for the salvaging of old maps which could be restored to usefulness by the addition of new roads, buildings, canals, and similar man-made features. Included in this group were the maps

covering the Sacramento and San Joaquin Valleys and some of the Los Angeles County maps. It was agreed that all maps made for publication on the 1:24,000 scale were also to be prepared for publication on the 1:62,500 scale by combining four of the larger-scale maps and redrafting.

Additional areas were injected into the program as capacity warranted and in accordance with priorities established by the State Engineer's office. Soon work was in progress on more than a hundred quadrangles exclusive of the Valley revision job which was completed in about a year's time. Early in 1949 the State Engineer approved, for inclusion in the cooperative program, the preparation of a 2-sheet base map of California, for publication on a scale of 1:500,000. The breakdown of the Survey's large printing presses at the time compilation was completed necessitated the printing of a interim edition of the base map on a scale of 1:633,600 (1 inch = 10 miles). The 1:500,000 scale map, including a shaded relief edition, is expected to be printed late this year. Mapping in the other six States of the Pacific Region was moving along at a normal pace, and capacity to meet the requirements of the California cooperative program was gradually being expanded when, shortly after the outbreak of the Korean War, an urgent request was received from the Department of Defense for the completion of high-priority defense mapping throughout the Nation. The three States bordering the Pacific Ocean were included in the critical zone and were allotted a large share of the funds provided for defense mapping. The Atomic Energy Commission also increased its demands on the Survey for topographic mapping, particularly in Utah and Arizona where strategic-mineral deposits were arousing more than passing interest. As a result of the increased emphasis on defense mapping, the balance of operations shifted considerably from the California program to Federal mapping in the region as a whole. The figures show that in fiscal year 1949 about 35 percent of the Pacific Region's funds were spent on California cooperative mapping, whereas in the current year, owing to the increase in money available for defense mapping, the cooperative funds amount to only about 20 percent of the Region's total funds.

In the State of California, work is now in progress on about 450 quadrangles. Of this number, about 120 are undergoing revision. The following tabulation provides some further information regarding the work in progress:

CALIFORNIA MAPPING IN PROGRESS

Size of Quadrangle	<u>COOP</u>		<u>FEDERAL</u>		<u>TOTALS</u>	
	New Mapping or Remapping	Revision	New Mapping or Remapping	Revision	New Mapping or Remapping	Revision
7½-minute (1:24,000)	130	8	90	91	220	99
15-minute (1:62,500)	75	9	46	14	121	23
Totals	205	17	136	105	341	122

The average elapsed time required for a map to pass through the production hopper from inception to publication is now down to about three years. Considering the handicaps and restrictions imposed by seasonal climatic conditions on field operations and procurement of aerial photography, this is a creditable accomplishment. The production line for topographic mapping,

as now carried on by the Geological Survey with modern equipment and procedures, can be divided into six major phases: (1) Procurement of aerial photographs. (2) Establishment of basic and supplemental control. (3) Stereo-compilation. (4) Field completion. (5) Final drafting, checking and editing. (6) Reproduction.

There follows a table showing in square miles the topographic mapping accomplished in California since the beginning of the enlarged cooperative program in 1946:

TOPOGRAPHIC MAPPING ACCOMPLISHED IN CALIFORNIA

Year	<u>1:24,000</u>	<u>1:62,500</u>	<u>New Mapping & Remapping</u>	<u>Revision</u>
1946		425	425	
1947	4,174	307	1,249	3,232
1948	3,458	2,420	5,039	839
1949	3,226	783	2,797	1,212
1950	1,883	3,786	5,088	581
1951	2,482	4,842	6,712	612
1952	<u>5,000</u>	<u>9,500</u>	<u>10,300</u>	<u>4,200</u>
Total	20,223	22,063	31,610	10,676

Although the figures indicate that, since 1946, topographic mapping has been completed for more than one-fourth of the area of the State, it should be pointed out that a large part of the work accomplished was revision and re-mapping of areas covered by old and obsolete mapping. The figure for topographic map coverage for California now stands at about 85 percent, but again, as brought out by the inventory and appraisal of 1945, a considerable number of the existing maps require remapping or revision.

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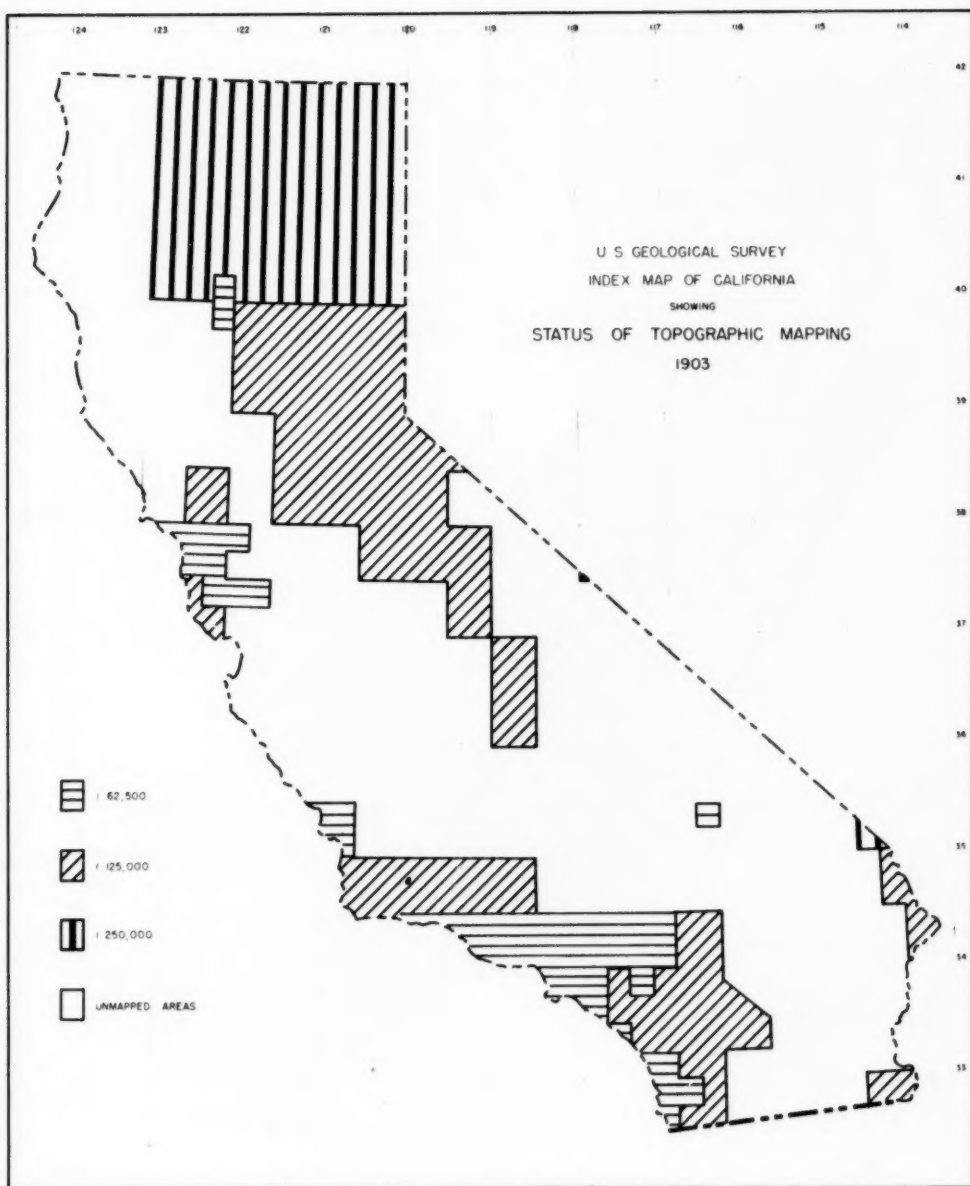
Twenty-Fifth Annual Report by the Director of the U. S. Geological Survey, 1903-1904.

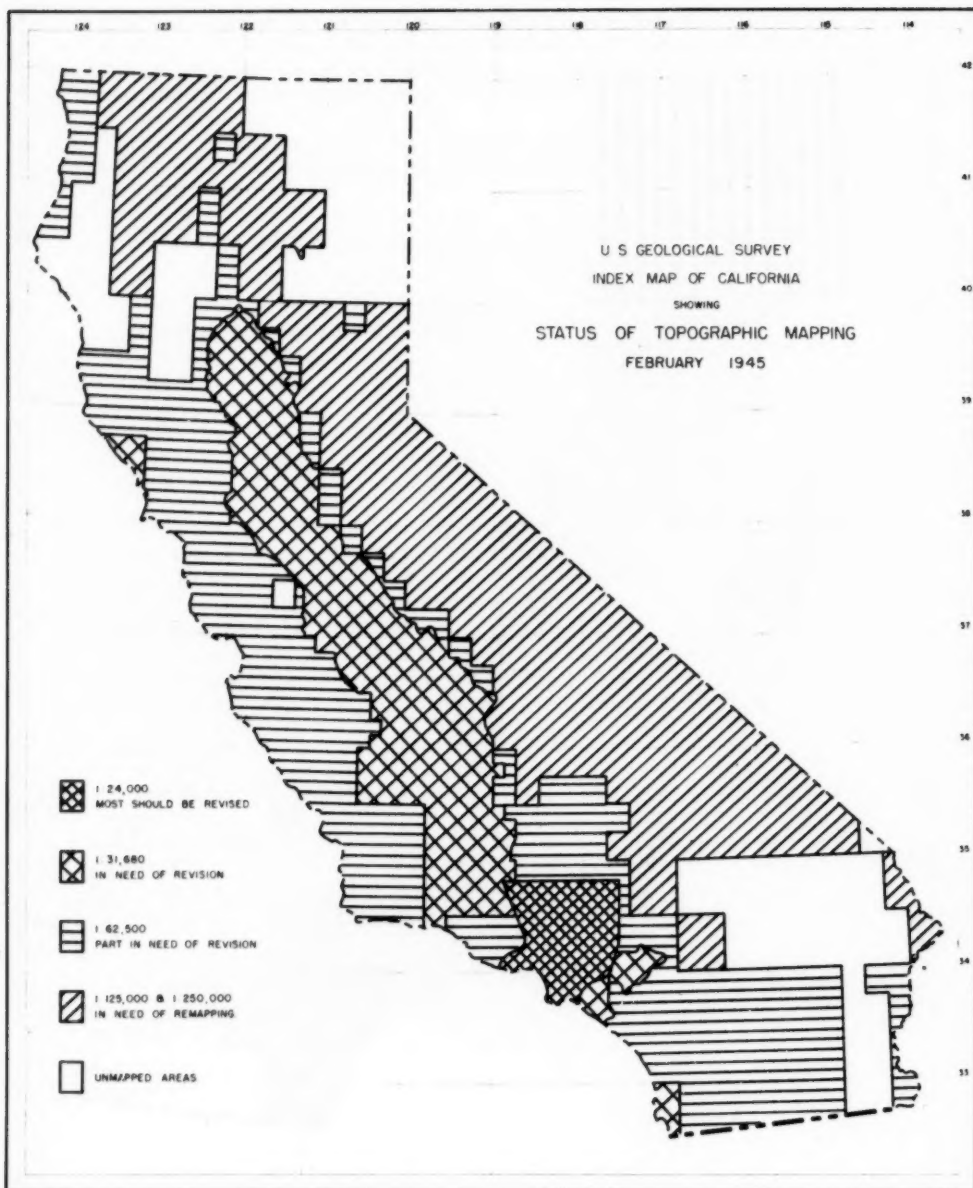
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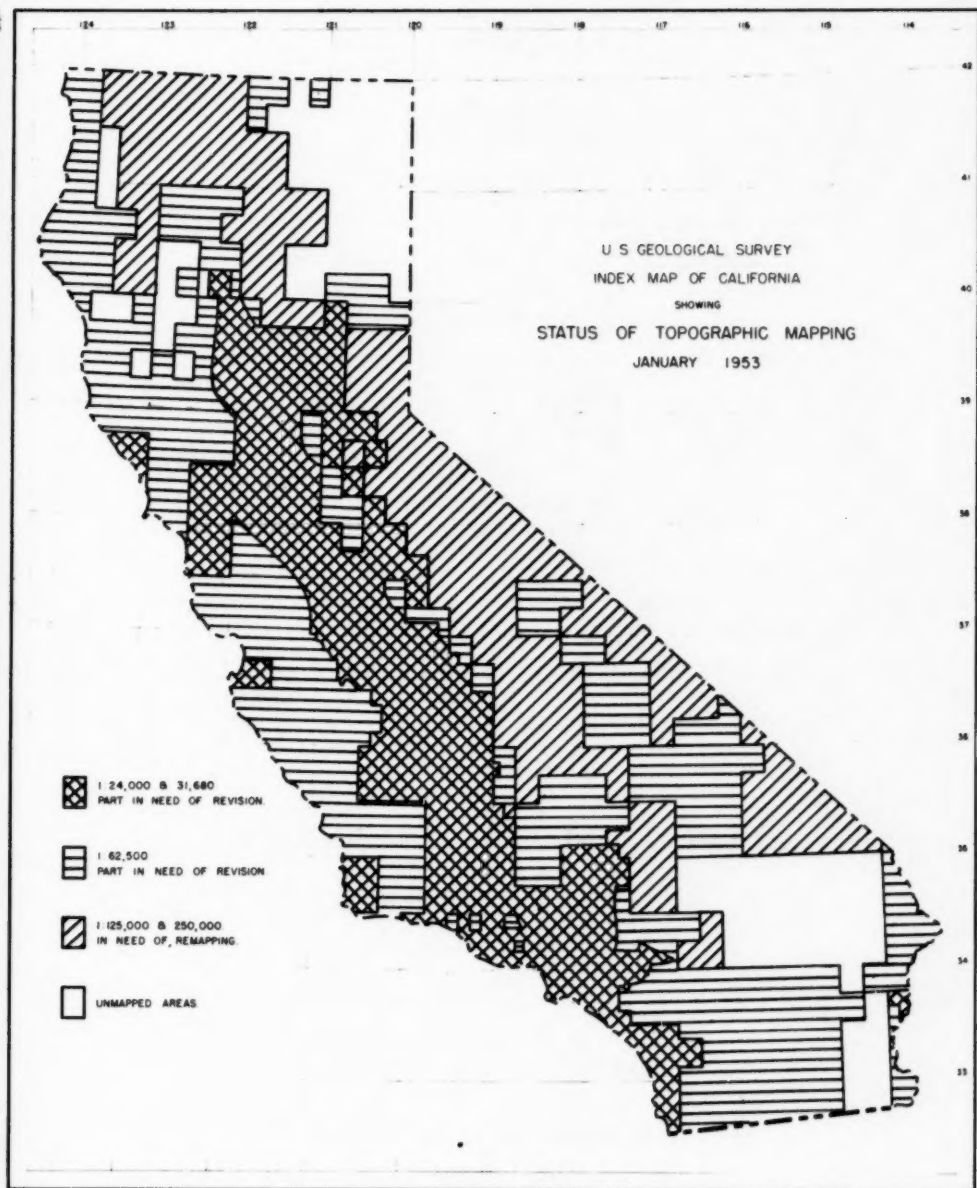
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